Syllabus

1. Data about the program of study

1.1 Institution	Technical University of Cluj-Napoca
1.2 Faculty	Automation and Computer Science
1.3 Department	Automation
1.4 Field of study	Systems Engineering
1.5 Cycle of study	Bachelor of Science
1.6 Program of study/Qualification	Automation and Applied Informatics (English)
1.7 Form of education	Full time
1.8 Codul disciplinei	25.00

2. Data about the subject

2.1 Subject name	***Signals and Systems***				
2.2 Course responsible/lecturer	Prof.dr.eng. Daniel Moga – daniel.moga@aut.utcluj.ro				
2.3 Teachers in charge of applications	Prof.dr.eng. Daniel Moga – daniel.moga@aut.utcluj.ro Sl.dr.eng. Nicoleta Stroia – nicoleta.stroia@aut.utcluj.ro				
2.4 Year of study	2	2.5 Semester	2	2.6 Assessment *(E/C/V)*	E
2.7 Type of subject	*DF – fundamental, DD – in the field, DS – specialty, DC – complementary*				DD
	DI – compulsory, DO – elective, Dfac – optional				DI

3. Estimated total time

3.1 Number of hours per week	4	of which:	Course	2	Seminar	0	Laboratory	2	Project	0
3.2 Number of hours per semester	56	of which:	course	28	Seminar	0	Laboratory	28	Project	0
3.3 Individual study										
(a) Manual, lecture material and notes, bibliography										14
(b) Supplementary study in the library, online and in the field										10
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays										17
(d) Tutoring										0
(e) Exams and tests										3
(f) Other activities:										0

3.4 Total hours of individual study (sum of (3.3(a)…3.3(f)))	44
3.5 Total hours per semester (3.2+3.4)	100
3.6 Number of credit points	4

4. Pre-requisites (where appropriate)

4.1 Curriculum	
4.2 Competence	Electric and electronic elementary circuits, Basic knowledge of systems theory, Elements of linear algebra and calculus, Elementary numerical methods

5. Requirements (where appropriate)

5.1. For the course	Blackboard, projector, computer / Internet access to online platforms
5.2. For the applications	Computers, specific software

6. Specific competences

6.1 Professional competences	C2 Operating with basic concepts of computer science, information technology and communication C2.2 Well grounded usage of concepts from informatics and computer technology in solving well defined problems of system engineering and in applications requiring the use of hardware or software in industrial systems or information technology systems. C2.5 Using hardware -software codesign and software engineering as development methodologies, including the system level modelling. C3 Operating with fundamentals of control engineering, process modelling, simulation, identification and analysis methods, and computer aided design.

	C3.1 Identification of basic concepts of system theory, control engineering, of fundamental principles of modelling and simulation, as well as of process analysis methods in order to explain the basic problems of the field
6.2 Cross competences	

7. Course objectives

7.1 General objective	Understanding and mastering of elementary techniques for signal representation and manipulation
7.2 Specific objectives	• Computation of continuous and discrete time signal parameters • Algorithms and circuits for implementing elementary signal processing methods • Learning of basic system analysis techniques • Students become acquainted with Matlab signal processing capabilities

8. Contents

8.1 Lecture	No.hours	Teaching methods	Notes
The concept of system. The concept of signal. Examples	2	Presentations, discussions	
Signals classification and properties. Sampling and aliasing. Sample and hold circuits	2		
Systems classification and properties. Interconnection of systems	2		
Representing signals in terms of impulses. Convolution of 1D discrete signals. Convolution of 2D discrete signals. Applications	2		
Properties of discrete LTI systems (causality, stability). Discrete linear filters. Representing continuous signals in terms of impulses. Convolution of continuous signals. Continuous filters	2		
Vector spaces. Projections on subspaces generated by orthogonal systems of functions.	2		
Fourier series representation of periodic signals. Extensions of non-periodic signals defined over a finite interval to periodic signals. Fourier Series for odd and even signals	2		
The approximation of a periodic signal using truncated Fourier series and convergence conditions. Gibbs phenomenon. Dirichlet conditions. Fourier Series as a projection	2		
Fourier series properties. Fourier series applications	2		
The concept of transforms. Fourier Transform	2		
Sampling theorem and aliasing. Fourier transform applications. 2D Fourier transform	2		
Discrete Fourier transform	2		
Digital signals compression. Discrete Cosine Transform and lossy compression. JPEG Algorithm	2		
Mellin Transform and applications	2		

Bibliography

1. A.V. Oppenheim, A.S. Willsky and S.H. Nawab, *Signals and Systems*, Prentice-Hall, Second Edition, 1997.
2. Adelaida Mateescu, *Semnale si sisteme*, Editura Teora, 2001.
3. J. G. Proakis, D. K. Manolakis. *Digital Signal Processing: Principles, Algorithms and Applications*. 3rd Edition, Prentice-Hall, Inc. 1996
4. A.V. Oppenheim, Ronald W. Schafer, and John R. Buck. *Discrete-Time Signal Processing*. 2nd Edition, Prentice-Hall, Inc., 1998
5. T. Dragomir, M. Voicu, D. Moga. Capitol 1: Fundamente Matematice, in *Automatica*, vol. I, coordonator: I. Dumitrache, Bucuresti, 2009, ISBN: 978-973-1883-4, Editura Academiei Romane
6. S. Damelin and W. Jr. Miller. *The Mathematics of Signal Processing.* Cambridge University Press. (2011)
7. L.F. Chaparro, *Signals and Systems using MATLAB*, Elsevier Inc., 2011, ISBN 978-0-12-374716-7
8. M. Lutovac, D. V. Tosic, B.L. Evans, *Filter Design for Signal Processing using MATLAB and Mathematica*, Prentice Hall; 1st edition September, 2000, ISBN 978-0201361308
9. E.S. Gopi. *Algorithm Collections for Digital Signal Processing Applications Using Matlab*, Springer, 2007, ISBN 978-1-4020-6410-4

10. D. Moga, G. Mocanu, R.A. Munteanu, *Vision Based Measurement and Control*, Editura Mediamira, ISBN 978-973-713-233-8, 2009
11. P. Corke. *Robotics, Vision and Control. Fundamental Algorithms in MATLAB*. 2011 Springer

8.2 Applications (seminar/laboratory/project)	No.hours	Teaching methods	Notes
Introduction to Matlab	2	Exercises, Implementation in Matlab	
Representing signals in Matlab	2		
Periodic signals	2		
Elementary signals	2		
System properties	2		
One-dimensional correlation applications for continuous and discrete periodic signals	2		
One-dimensional discrete signals convolution	2		
Bidimensional convolution and image filtering	2		
Bidimensional correlation and template matching	2		
Fourier series	2		
Shape descriptors. Fourier descriptors	2		
Discrete Fourier transform applications	4		
Frequency domain filtering of bidimensional signals	2		

Bibliography

1. S. Chapman. *MATLAB programming for engineers*. Cengage Learning, 2007.
2. V. Ingle and J. Proakis. *Digital signal processing using MATLAB*. Cengage Learning, 2011.
3. B. Hahn and D. Valentine. *Essential MATLAB for engineers and scientists*. Newnes, 2007.
4. D. Halpern, H. B. Wilson, and L. H. Turcotte. *Advanced mathematics and mechanics applications using MATLAB*. CRC press, 2002.
5. S. T. Karris. *Signals and systems with MATLAB applications*. Orchard Publications, 2003.
6. R. Schilling and S. Harris. *Fundamentals of digital signal processing using MATLAB*. Cengage Learning, 2011.
7. M. Weeks. *Digital Signal Processing Using MATLAB & Wavelets*. Jones & Bartlett Learning, 2010.
8. G. Blanchet and M. Charbit. *Digital signal and image processing using MATLAB*, Iste London, 2006.
9. M. S. Nixon and A. S. Aguado. *Feature extraction & image processing for computer vision*. Academic Press, 2012.

9. Bridging course contents with the expectations of the representatives of the community, professional associations and employers in the field

Laboratory applications content was discussed with industry representatives and employers in the field

10. Evaluation

Activity type	Assessment criteria	Assessment methods	Weight in the final grade
Course – Module 1 (weeks 1-6)	Knowledge of applications of vector spaces and projection methods to the representation of signals; Properties of systems; Applications of convolution.	Module 1 Verification - Written exam (E1)	30%
Course – Module 2 (weeks 7-14)	Knowledge of methods for signal representation, analysis and synthesis. Applications of transforms in systems analysis.	Module 2 Verification - Written exam (E2)	30%
Seminar	-		
Laboratory	Skills related to: - representation and manipulation of signals using Matlab signal processing functions - applied methods for analysis and synthesis of the signals - applied methods for inspecting systems properties	(L) Practical assessment	40%
Project	-		
Minimum standard of performance: Exam grade E1 ≥ 5, Exam grade E2 ≥ 5, Final grade ≥ 5			

Date of filling in:		Title Firstname NAME	Signature
20.06.2024	Course	Prof.dr.eng. Daniel MOGA	
	Applications	Prof.dr.eng. Daniel MOGA	
		Sl.dr.eng. Nicoleta STROIA	

Date of approval by the Automation Department Board _____	Head of Automation Department Prof.dr.ing. Honoriu VĂLEAN
Date of approval by the Automation and Computer Science Faculty Council _____	Dean Prof.dr.ing. Mihaela DINSOREANU